

10/567763

IAP5 Rec'd PCT/PTO 10 FEB 2006

21864wo.ST25.txt
SEQUENCE LISTING

<110> DSM IP Assets B.V.

<120> Microbial production of L-ascorbic acid

<130> 21864 WO

<150> EP 03017677.0

<151> 2003-08-14

<160> 31

<170> PatentIn version 3.2

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<212> DNA

<213> Gluconobacter oxydans N44-1

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Leu Gly Gly Ser Trp Phe Tyr Thr Leu Ala Gly Ile Ala Leu Ala Ala
35 40 45

Ser Ser Val Tyr Met Ile Arg Arg Asn Ile Leu Ser Thr Trp Ile Ala
50 55 60

Leu Gly Leu Leu Val Ala Thr Ala Leu Trp Ser Leu Ala Glu Val Gly
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Pro Gly Ser Tyr Tyr Pro Thr Ala Ala Pro Leu Val Ala Gly Asp Ile
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 Val Val Val Gly Gly Arg Ile Ala Asp Asn Glu Arg Thr Gly Glu Pro
 340 345 350
 Ser Gly Val Val Arg Gly Tyr Asp Val Arg Thr Gly Ala Gln Val Trp
 355 360 365
 Ala Trp Asp Ala Thr Asn Pro His Arg Gly Thr Thr Pro Leu Ala Glu
 370 375 380
 Gly Glu Ile Tyr Pro Ala Glu Thr Pro Asn Met Trp Gly Thr Ala Ser
 385 390 395 400
 Tyr Asp Pro Lys Leu Asn Leu Val Phe Phe Pro Leu Gly Asn Gln Thr
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 Pro Asp Phe Trp Gly Gly Asp Arg Ser Lys Ala Ser Asp Glu Tyr Asn
 420 425 430
 Asp Ala Phe Val Ala Val Asp Ala Lys Thr Gly Asp Glu Arg Trp His
 435 440 445
 Phe Arg Thr Ala Asn His Asp Leu Val Asp Tyr Asp Ala Thr Ala Gln
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 465 470 475 480
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 485 490 495
 Asp Gly Thr Pro Ile Val Pro Val Glu Met Arg Lys Val Pro Gln Asp
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 Gly Ala Pro Glu His Gln Tyr Leu Ala Pro Glu Gln Pro Tyr Ser Ala
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 530 535 540
 Thr Ile Phe Asp Gln Leu Leu Cys Arg Ile Gln Phe Ala Ser Tyr Arg
 545 550 555 560
 Tyr Glu Gly Glu Phe Thr Pro Val Asn Glu Lys Gln Ala Thr Ile Ile
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Gly Lys Phe Met Lys Gln Glu Glu Ala Arg Arg Ser Gly Phe Lys Pro
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Ser Ser Glu Gly Glu Tyr Ser Glu Gln Lys Gly Thr Pro Trp Gly Val
625 630 635 640

Val Arg Ser Met Phe Phe Ser Pro Ala Gly Leu Pro Cys Val Lys Pro
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Pro Tyr Gly Thr Met Asn Ala Ile Asp Leu Arg Ser Gly Lys Val Lys
660 665 670

Trp Ser Met Pro Leu Gly Thr Ile Gln Asp Met Pro Val His Gly Met
675 680 685

Val Pro Gly Leu Ala Ile Pro Leu Gly Met Pro Thr Met Ser Gly Pro
690 695 700

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705 710 715 720

Tyr Val Arg Ala Leu Asn Thr Asp Thr Gly Glu Val Val Trp Lys Ala
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Lys Thr Gly Lys Gln Tyr Ile Val Val Thr Ala Gly Gly Leu Thr Arg
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 35 40 45

Tyr Ser Ala Leu Ser Ile Gly Thr Glu Arg Leu Lys Pro Ser Asp Met
 50 55 60

Trp Gly Gly Thr Ile Phe Asp Gln Leu Leu Cys Arg Ile Gln Phe Ala
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Ser Tyr Arg Tyr Glu Gly Glu Phe Thr Pro Val Asn Glu Lys Gln Ala
 85 90 95

Thr Ile Ile Tyr Pro Gly Tyr Tyr Gly Gly Ile Asn Trp Gly Gly Gly
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Ala Val Asp Glu Ser Thr Gly Thr Leu Leu Val Asn Asp Ile Arg Met
 115 120 125

Ala Gln Trp Gly Lys Phe Met Lys Gln Glu Glu Ala Arg Arg Ser Gly
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Phe Lys Pro Ser Ser Glu Gly Glu Tyr Ser Glu Gln Lys Gly Thr Pro
 145 150 155 160

Trp Gly Val Val Arg Ser Met Phe Phe Ser Pro Ala Gly Leu Pro Cys
 165 170 175

Val Lys Pro Pro Tyr Gly Thr Met Asn Ala Ile Asp Leu Arg Ser Gly
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Lys Val Lys Trp Ser Met Pro Leu Gly Thr Ile Gln Asp Met Pro Val
 195 200 205

His Gly Met Val Pro Gly Leu Ala Ile Pro Leu Gly Met Pro Thr Met
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Ser Gly Pro Leu Ala Thr His Thr Gly Leu Val Phe Phe Ser Gly Thr
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Gly Ile Ala Leu Ala Ala Ser Ser Val Tyr Met Ile Arg Arg Asn Ile
35 40 45
Leu Ser Thr Trp Ile Ala Leu Gly Leu Leu Val Ala Thr Ala Leu Trp
50 55 60
Ser Leu Ala Glu Val Gly Thr Ser Phe Trp Pro Ser Phe Ser Arg Leu
65 70 75 80
Ile Val Phe Leu Cys Val Ala Leu Ile Ala Thr Leu Met Ala Pro Trp
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35 40 45

Thr Glu Lys Trp Lys Phe Asp Pro His Ala Gln Thr Lys Val Trp Gln
50 55 60

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Arg Cys Arg Gly Val Gly Tyr Trp His Asp Ser Thr Ala Thr Asp Ala
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Asn Ala Pro Cys Ala Ser Arg Ile Val Leu Thr Thr Ile Asp Ala Arg
85 90 95

Leu Ile Thr Ile Asp Ala Arg Thr Gly Gln Ala Cys Thr Asp Phe Gly
100 105 110

Thr Asn Gly Asn Val Asn Leu Leu Thr Gly Leu Gly Pro Thr Ala Pro
115 120 125

Gly Ser Tyr Tyr Pro Thr Ala Ala Pro Leu Val Ala Gly Asp Ile Val
130 135 140

Val Val Gly Gly Arg Ile Ala Asp Asn Glu Arg Thr Gly Glu Pro Ser
145 150 155 160

Gly Val Val Arg Gly Tyr Asp Val Arg Thr Gly Ala Gln Val Trp Ala
165 170 175

Trp Asp Ala Thr Asn Pro His Arg Gly Thr Thr Pro Leu Ala Glu Gly
180 185 190

Glu Ile Tyr Pro Ala Glu Thr Pro Asn Met Trp Gly Thr Ala Ser Tyr
195 200 205

Asp Pro Lys Leu Asn Leu Val Phe Phe Pro Leu Gly Asn Gln Thr Pro
210 215 220

Asp Phe Trp Gly Gly Asp Arg Ser Lys Ala Ser Asp Glu Tyr Asn Asp
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 35 40 45

Ser Asp Met Trp Gly Gly Thr Ile Phe Asp Gln Leu Leu Cys Arg Ile
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Gln Phe Ala Ser Tyr Arg Tyr Glu Gly Glu Phe Thr Pro Val Asn Glu
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Lys Gln Ala Thr Ile Ile Tyr Pro Gly Tyr Tyr Gly Gly Ile Asn Trp
 85 90 95

Gly Gly Gly Ala Val Asp Glu Ser Thr Gly Thr Leu Leu Val Asn Asp
 100 105 110

Ile Arg Met Ala Gln Trp Gly Lys Phe Met Lys Gln Glu Glu Ala Arg
 115 120 125

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Arg Ser Gly Phe Lys Pro Ser Ser Glu Gly Glu Tyr Ser Glu Gln Lys
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145 150 155 160

Leu Pro Cys Val Lys Pro Pro Tyr Gly Thr Met Asn Ala Ile Asp Leu
165 170 175

Arg Ser Gly Lys Val Lys Trp Ser Met Pro Leu Gly Thr Ile Gln Asp
180 185 190

Met Pro Val His Gly Met Val Pro Gly Leu Ala Ile Pro Leu Gly Met
195 200 205

Pro Thr Met Ser Gly Pro Leu Ala Thr His Thr Gly Leu Val Phe Phe
210 215 220

Ser Gly Thr Leu Asp Asn Tyr Val Arg Ala Leu Asn Thr Asp Thr Gly
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gtntacatga tccgtcgcaa catcctctcg acatggatcg ccctcggcct gcttgtagca 180
acagccctgt ggtcgtcgc cgaagtcggc accagcttct ggcccagctt ctccgcctg 240
atcgtgttcc tgtgcgtcgc cctgatcgcg acttcatgg cgccctggct cagcggcccc 300
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 35 40 45

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Ser Leu Ala Glu Val Gly Thr Ser Phe Trp Pro Ser Phe Ser Arg Leu
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Ile Val Phe Leu Cys Val Ala Leu Ile Ala Thr Leu Met Ala Pro Trp
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ccgccccct cgtggcgggt gacatcgtgg tcgtcggcgg ccgcatcgcc gataacgagc	480
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35 40 45

Asp Pro Asp Thr Gly Thr Glu Lys Trp Lys Phe Asp Pro His Ala Gln
50 55 60

Thr Lys Val Trp Gln Arg Cys Arg Gly Val Gly Tyr Trp His Asp Ser
65 70 75 80

Thr Ala Thr Asp Ala Asn Ala Pro Cys Ala Ser Arg Ile Val Leu Thr
85 90 95

Thr Ile Asp Ala Arg Leu Ile Thr Ile Asp Ala Arg Thr Gly Gln Ala
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Cys Thr Asp Phe Gly Thr Asn Gly Asn Val Asn Leu Leu Thr Gly Leu
115 120 125

Gly Pro Thr Ala Pro Gly Ser Tyr Tyr Pro Thr Ala Ala Pro Leu Val
130 135 140

Ala Gly Asp Ile Val Val Val Gly Gly Arg Ile Ala Asp Asn Glu Arg
145 150 155 160

Thr Gly Glu Pro Ser Gly Val Val Arg Gly Tyr Asp Val Arg Thr Gly
165 170 175

Ala Gln Val Trp Ala Trp Asp Ala Thr Asn Pro His Arg Gly Thr Thr
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21864wo.ST25.txt

Pro Leu Ala Glu Gly Glu Ile Tyr Pro Ala Glu Thr Pro Asn Met Trp
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Gly Thr Ala Ser Tyr Asp Pro Lys Leu Asn Leu Val Phe Phe Pro Leu
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Gly Asn Gln Thr Pro Asp Phe Trp Gly Gly Asp Arg Ser Lys Ala Ser
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Asp Glu Tyr Asn Asp Ala Phe Val Ala Val Asp Ala
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<220>
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21864wo.ST25.txt

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<400> 27

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Leu Gly Gly Ser Trp Phe Tyr Thr Leu Ala Gly Ile Ala Leu Ala Ala
 35 40 45

Ser Ser Val Tyr Met Ile Arg Arg Asn Ile Leu Ser Thr Trp Ile Ala
 50 55 60

Leu Gly Leu Leu Val Ala Thr Ala Leu Trp Ser Leu Ala Glu Val Gly
 65 70 75 80

Thr Ser Phe Trp Pro Ser Phe Ser Arg Leu Ile Val Phe Leu Cys Val
 85 90 95

Ala Leu Ile Ala Thr Leu Met Ala Pro Trp Leu Ser Gly Pro Gly Arg
 100 105 110

Arg Tyr Phe Thr Arg Pro Val Thr Gly Ala Thr Ser Gly Ala Leu Gly
 115 120 125

Ala Ile Ile Val Ala Phe Leu Ala Gly Met Phe Arg Val His Pro Thr
 130 135 140

Ile Ala Pro Gln Asp Thr Thr His Pro Gln Glu Thr Ala Ser Thr Ala
 145 150 155 160

Asp Ser Asp Gln Pro Gly His Asp Trp Pro Ala Tyr Gly Arg Thr Ala
 165 170 175

21864wo.ST25.txt

Ser Gly Thr Arg Tyr Ala Ser Phe Thr Gln Ile Asn Arg Asp Asn Val
180 185 190

Ser Lys Leu Arg Val Ala Trp Thr Tyr Arg Thr Gly Asp Met Ala Leu
195 200 205

Asn Gly Ala Glu Phe Gln Gly Thr Pro Ile Lys Ile Gly Asp Thr Val
210 215 220

Tyr Ile Cys Ser Pro His Asn Ile Val Ser Ala Leu Asp Pro Asp Thr
225 230 235 240

Gly Thr Glu Lys Trp Lys Phe Asp Pro His Ala Gln Thr Lys Val Trp
245 250 255

Gln Arg Cys Arg Gly Val Gly Tyr Trp His Asp Ser Thr Ala Thr Asp
260 265 270

Ala Asn Ala Pro Cys Ala Ser Arg Ile Val Leu Thr Thr Ile Asp Ala
275 280 285

Arg Leu Ile Thr Ile Asp Ala Arg Thr Gly Gln Ala Cys Thr Asp Phe
290 295 300

Gly Thr Asn Gly Asn Val Asn Leu Leu Thr Gly Leu Gly Pro Thr Ala
305 310 315 320

Pro Gly Ser Tyr Tyr Pro Thr Ala Ala Pro Leu Val Ala Gly Asp Ile
325 330 335

Val Val Val Gly Gly Arg Ile Ala Asp Asn Glu Arg Thr Gly Glu Pro
340 345 350

Ser Gly Val Val Arg Gly Tyr Asp Val Arg Thr Gly Ala Gln Val Trp
355 360 365

Ala Trp Asp Ala Thr Asn Pro His Arg Gly Thr Thr Pro Leu Ala Glu
370 375 380

Gly Glu Ile Tyr Pro Ala Glu Thr Pro Asn Met Trp Gly Thr Ala Ser
385 390 395 400

Tyr Asp Pro Lys Leu Asn Leu Val Phe Phe Pro Leu Gly Asn Gln Thr
405 410 415

Pro Asp Phe Trp Gly Gly Asp Arg Ser Lys Ala Ser Asp Glu Tyr Asn
420 425 430

21864wo.ST25.txt

Asp Ala Phe Val Ala Val Asp Ala Lys Thr Gly Asp Glu Arg Trp His
435 440 445

Phe Arg Thr Ala Asn His Asp Leu Val Asp Tyr Asp Ala Thr Ala Gln
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Pro Ile Leu Tyr Asp Ile Pro Asp Gly His Gly Gly Thr Arg Pro Ala
465 470 475 480

Ile Ile Ala Met Thr Lys Arg Gly Gln Ile Phe Val Leu Asp Arg Arg
485 490 495

Asp Gly Thr Pro Ile Val Pro Val Glu Met Arg Lys Val Pro Gln Asp
500 505 510

Gly Ala Pro Glu His Gln Tyr Leu Ala Pro Glu Gln Pro Tyr Ser Ala
515 520 525

Leu Ser Ile Gly Thr Glu Arg Leu Lys Pro Ser Asp Met Trp Gly Gly
530 535 540

Thr Ile Phe Asp Gln Leu Leu Cys Arg Ile Gln Phe Ala Ser Tyr Arg
545 550 555 560

Tyr Glu Gly Glu Phe Thr Pro Val Asn Glu Lys Gln Ala Thr Ile Ile
565 570 575

Tyr Pro Gly Tyr Tyr Gly Gly Ile Asn Trp Gly Gly Gly Ala Val Asp
580 585 590

Glu Ser Thr Gly Thr Leu Leu Val Asn Asp Ile Arg Met Ala Gln Trp
595 600 605

Gly Lys Phe Met Lys Gln Glu Glu Ala Arg Arg Ser Gly Phe Lys Pro
610 615 620

Ser Ser Glu Gly Glu Tyr Ser Glu Gln Lys Gly Thr Pro Trp Gly Val
625 630 635 640

Val Arg Ser Met Phe Phe Ser Pro Ala Gly Leu Pro Cys Val Lys Pro
645 650 655

Pro Tyr Gly Thr Met Asn Ala Ile Asp Leu Arg Ser Gly Lys Val Lys
660 665 670

Trp Ser Met Pro Leu Gly Thr Ile Gln Asp Met Pro Val His Gly Met
Page 20

675

680

685

Val Pro Gly Leu Ala Ile Pro Leu Gly Met Pro Thr Met Ser Gly Pro
690 695 700

Leu Ala Thr His Thr Gly Leu Val Phe Phe Ser Gly Thr Leu Asp Asn
705 710 715 720

Tyr Val Arg Ala Leu Asn Thr Asp Thr Gly Glu Val Val Trp Lys Ala
725 730 735

Arg Leu Pro Val Ala Ser Gln Ala Ala Pro Met Ser Tyr Met Ser Asp
740 745 750

Lys Thr Gly Lys Gln Tyr Ile Val Val Thr Ala Gly Gly Leu Thr Arg
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Pro Ser Glu Glu
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